

DRV883x Low-Voltage H-Bridge Driver

1 Features

- H-Bridge Motor Driver
 - Drives a DC Motor or Other Loads
 - Low MOSFET On-Resistance: HS + LS 280 mΩ
- 1.8-A Maximum Drive Current
- Separate Motor and Logic Supply Pins:
 - Motor VM: 0 to 11 V
 - Logic VCC: 1.8 to 7 V
- PWM or PH-EN Interface
 - DRV8837: PWM, IN1 and IN2
 - DRV8838: PH and EN
- Low-Power Sleep Mode With 120-nA Maximum Sleep Current
 - nSLEEP pin
- Small Package and Footprint
 - 8-Pin WSON With Thermal Pad
 - 2.0 × 2.0 mm
- Protection Features
 - VCC Undervoltage Lockout (UVLO)
 - Overcurrent Protection (OCP)
 - Thermal Shutdown (TSD)

2 Applications

- Cameras
- DSLR Lenses
- Consumer Products
- Toys
- Robotics
- Medical Devices

3 Description

The DRV883x family of devices provides an integrated motor driver solution for cameras, consumer products, toys, and other low-voltage or battery-powered motion control applications. The device can drive one dc motor or other devices like solenoids. The output driver block consists of N-channel power MOSFETs configured as an H-bridge to drive the motor winding. An internal charge pump generates needed gate drive voltages.

The DRV883x family of devices can supply up to 1.8 A of output current. It operates on a motor power supply voltage from 0 to 11 V, and a device power supply voltage of 1.8 V to 7 V.

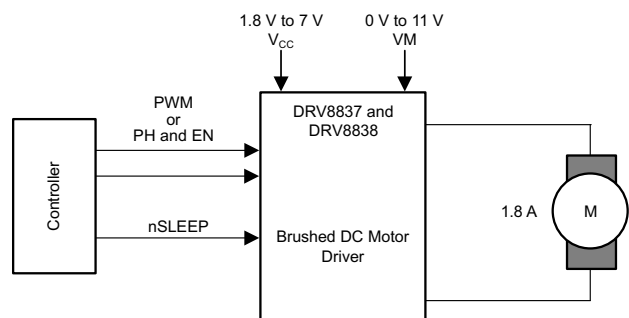
The DRV8837 device has a PWM (IN1-IN2) input interface; the DRV8838 device has a PH-EN input interface. Both interfaces are compatible with industry-standard devices.

Internal shutdown functions are provided for overcurrent protection, short-circuit protection, undervoltage lockout, and overtemperature.

Device Information⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|----------|-------------------|
| DRV8837 | WSON (8) | 2.00 mm × 2.00 mm |
| DRV8838 | | |

- (1) For all available packages, see the orderable addendum at the end of the data sheet.



DRV883x Simplified Diagram

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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision E (June 2016) to Revision F (April 2021) | Page |
|---|-------------|
| • Updated the numbering format for tables, figures, and cross-references throughout the document..... | 1 |
| • Added in the <i>Independent Half-Bridge Control</i> section..... | 13 |

| Changes from Revision D (December 2015) to Revision E (June 2016) | Page |
|---|-------------|
| • Changed the threshold type to the input logic voltage parameters in the <i>Electrical Characteristics</i> table..... | 8 |
| • Changed the units for the input logic hysteresis parameter from mV to V in the <i>Electrical Characteristics</i> table..... | 8 |
| • Added the <i>Receiving Notification of Documentation Updates</i> section | 21 |

| Changes from Revision C (February 2014) to Revision D (December 2015) | Page |
|---|-------------|
| • Clarified the input interface for each device in the <i>Description</i> section | 1 |
| • Added CDM and HBM ESD ratings to the <i>ESD Ratings</i> table | 6 |

| Changes from Revision B (December 2013) to Revision C (February 2014) | Page |
|---|-------------|
| • Added the DRV8838 device information, specifications, and timing diagrams..... | 1 |
| • Added Device Information table..... | 1 |
| • Added a PWM interface diagram | 1 |
| • Added more information to the Detailed Description and moved information from the Functional Description ... | 11 |
| • Added functional block diagram for DRV8838 | 11 |
| • Added the <i>Application and Implementation</i> section | 17 |
| • Added <i>Power Supply Recommendations</i> , <i>Layout</i> , <i>Device and Documentation Support</i> , and <i>Mechanical, Packaging, and Orderable Information</i> sections..... | 19 |

| Changes from Revision A (August 2012) to Revision B (December 2013) | Page |
|--|--------------------|
| • Changed Features section..... | 1 |
| • Changed Recommended Operating Conditions..... | 6 |
| • Changed Electrical Characteristics section..... | 8 |
| • Changed Timing Requirements section..... | 9 |
| • Changed Power Supplies and Input Pins section..... | 16 |

5 Pin Configuration and Functions

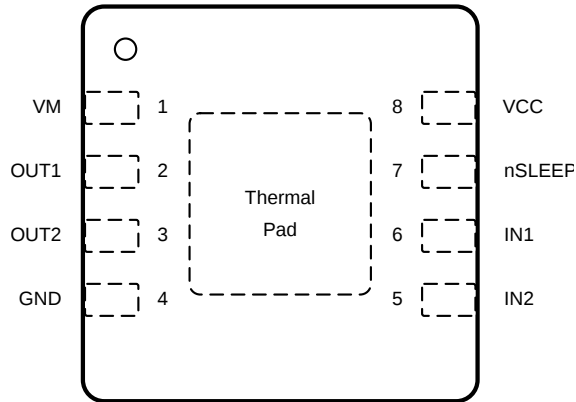


Figure 5-1. DSG Package 8-Pin WSON With Thermal Pad DRV8837 Top View

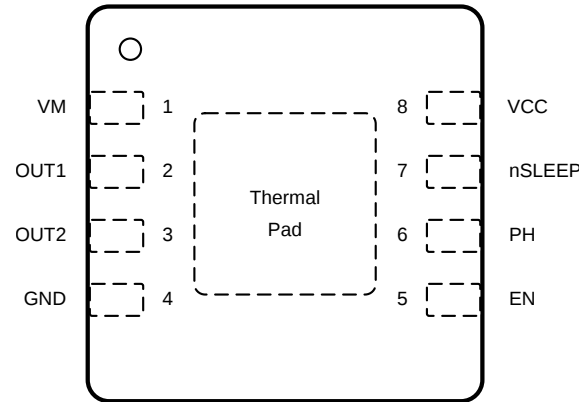


Figure 5-2. DSG Package 8-Pin WSON With Thermal Pad DRV8838 Top View

Pin Functions

| PIN | | | I/O | DESCRIPTION |
|------------------|---------|---------|-----|--|
| NAME | NO. | | | |
| | DRV8837 | DRV8838 | | |
| POWER AND GROUND | | | | |
| GND | 4 | 4 | — | Device ground This pin must be connected to ground. |
| VCC | 8 | 8 | I | Logic power supply Bypass this pin to the GND pin with a 0.1-μF ceramic capacitor rated for VCC. |
| VM | 1 | 1 | I | Motor power supply Bypass this pin to the GND pin with a 0.1-μF ceramic capacitor rated for VM. |
| CONTROL | | | | |
| EN | — | 5 | I | ENABLE input |
| IN1 | 6 | — | I | IN1 input See the Section 7 section for more information. |
| IN2 | 5 | — | I | IN2 input See the Section 7 section for more information. |
| PH | — | 6 | I | PHASE input See the Section 7 section for more information. |
| nSLEEP | 7 | 7 | I | Sleep mode input When this pin is in logic low, the device enters low-power sleep mode. The device operates normally when this pin is logic high. Internal pulldown |
| OUTPUT | | | | |
| OUT1 | 2 | 2 | O | Motor output |
| OUT2 | 3 | 3 | O | Connect these pins to the motor winding. |

5.1 Dapper Pin Functions

| NAME | PIN NO. | | I/O | DESCRIPTION |
|------|---------|---------|-----|---|
| | DRV8837 | DRV8838 | | |
| GND | 4 | 4 | — | Device ground This pin must be connected to ground. |
| VCC | 8 | 8 | I | Logic power supply Bypass this pin to the GND pin with a 0.1-μF ceramic capacitor rated for VCC. |

| PIN | | | I/O | DESCRIPTION |
|--------|----------------|----------------|-----|--|
| NAME | DRV8837 NO. | DRV8838 NO. | | |
| VM | 1 | 1 | I | Motor power supply Bypass this pin to the GND pin with a 0.1-μF ceramic capacitor rated for VM. |
| EN | — | 5 | I | ENABLE input |
| IN1 | 6 | — | I | IN1 input See the Section 7 section for more information. |
| IN2 | 5 | — | I | IN2 input See the Section 7 section for more information. |
| PH | — | 6 | I | PHASE input See the Section 7 section for more information. |
| nSLEEP | 7 | 7 | I | Sleep mode input When this pin is in logic low, the device enters low-power sleep mode. The device operates normally when this pin is logic high. Internal pulldown |
| OUT1 | 2 | 2 | O | Motor output Connect these pins to the motor winding. |
| OUT2 | 3 | 3 | O | |

6 Specifications

6.1 Absolute Maximum Ratings

over operating ambient temperature range (unless otherwise noted)^{(1) (2)}

| | | MIN | MAX | UNIT |
|--|--------------------------|--------------------|-----|------|
| Motor power-supply voltage | VM | −0.3 | 12 | V |
| Logic power-supply voltage | VCC | −0.3 | 7 | V |
| Control pin voltage | IN1, IN2, PH, EN, nSLEEP | −0.5 | 7 | V |
| Peak drive current | OUT1, OUT2 | Internally limited | | A |
| Operating virtual junction temperature, T _J | | −40 | 150 | °C |
| Storage temperature, T _{stg} | | −60 | 150 | °C |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values are with respect to network ground pin.

6.2 ESD Ratings

over operating ambient temperature range (unless otherwise noted)

| | | | VALUE | UNIT |
|--------------------|-------------------------|--|-------|------|
| V _(ESD) | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | ±3000 | V |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | ±1500 | |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating ambient temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT |
|--------------------|----------------------------------|-----|-----|------|
| VM | Motor power supply voltage | 0 | 11 | V |
| VCC | Logic power supply voltage | 1.8 | 7 | V |
| I _{OUT} | Motor peak current | 0 | 1.8 | A |
| f _{PWM} | Externally applied PWM frequency | 0 | 250 | kHz |
| V _{LOGIC} | Logic level input voltage | 0 | 5.5 | V |
| T _A | Operating ambient temperature | −40 | 85 | °C |

- (1) Power dissipation and thermal limits must be observed.

6.4 Thermal Information

over operating free-air temperature range (unless otherwise noted)

| THERMAL METRIC ⁽¹⁾ | | DRV883x | UNIT |
|-------------------------------|--|------------|------|
| | | DSG (WSON) | |
| | | 8 PINS | |
| R _{θJA} | Junction-to-ambient thermal resistance | 60.9 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 71.4 | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 32.2 | °C/W |
| ψ _{JT} | Junction-to-top characterization parameter | 1.6 | °C/W |
| ψ _{JB} | Junction-to-board characterization parameter | 32.8 | °C/W |

over operating free-air temperature range (unless otherwise noted)

| THERMAL METRIC ⁽¹⁾ | DRV883x | UNIT |
|---|------------|------|
| | DSG (WSON) | |
| | 8 PINS | |
| $R_{\theta JC(bot)}$ Junction-to-case (bottom) thermal resistance | 9.8 | °C/W |

- (1) For more information about traditional and new thermal limits, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

6.5 Electrical Characteristics

$T_A = 25^\circ\text{C}$, over recommended operating conditions unless otherwise noted

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|--|------------|------------|-----|------|
| POWER SUPPLIES (VM, VCC) | | | | | | |
| VM | VM operating voltage | | 0 | | 11 | V |
| I _{VM} | VM operating supply current | VM = 5 V; VCC = 3 V; No PWM | | 40 | 100 | μA |
| | | VM = 5 V; VCC = 3 V; 50 kHz PWM | | 0.8 | 1.5 | mA |
| I _{VMQ} | VM sleep mode supply current | VM = 5 V; VCC = 3 V; nSLEEP = 0 | | 30 | 95 | nA |
| VCC | VCC operating voltage | | 1.8 | | 7 | V |
| I _{VCC} | VCC operating supply current | VM = 5 V; VCC = 3 V; No PWM | | 300 | 500 | μA |
| | | VM = 5 V; VCC = 3 V; 50 kHz PWM | | 0.7 | 1.5 | mA |
| I _{VCCQ} | VCC sleep mode supply current | VM = 5 V; VCC = 3 V; nSLEEP = 0 | | 5 | 25 | nA |
| CONTROL INPUTS (IN1 or PH, IN2 or EN, nSLEEP) | | | | | | |
| V _{IL} | Input logic-low voltage falling threshold | | 0.25 × VCC | 0.38 × VCC | | V |
| V _{IH} | Input logic-high voltage rising threshold | | 0.46 × VCC | 0.5 × VCC | | V |
| V _{HYS} | Input logic hysteresis | | 0.08 × VCC | | | V |
| I _{IL} | Input logic low current | V _{IN} = 0 V | –5 | | 5 | μA |
| I _{IH} | Input logic high current | V _{IN} = 3.3 V | | | 50 | μA |
| | | V _{IN} = 3.3 V, DRV8838 nSLEEP pin | | 60 | | μA |
| R _{PD} | Pulldown resistance | | | 100 | | kΩ |
| | | DRV8838 nSLEEP pin | | 55 | | kΩ |
| MOTOR DRIVER OUTPUTS (OUT1, OUT2) | | | | | | |
| r _{DS(on)} | HS + LS FET on-resistance | VM = 5 V; VCC = 3 V; I _O = 800 mA; T _J = 25°C | | 280 | 330 | mΩ |
| I _{OFF} | Off-state leakage current | V _{OUT} = 0 V | –200 | | 200 | nA |
| PROTECTION CIRCUITS | | | | | | |
| V _{UVLO} | VCC undervoltage lockout | VCC falling | | | 1.7 | V |
| | | VCC rising | | | 1.8 | |
| I _{OCP} | Overcurrent protection trip level | | 1.9 | | 3.5 | A |
| t _{DEG} | Overcurrent deglitch time | | | 1 | | μs |
| t _{RETRY} | Overcurrent retry time | | | 1 | | ms |
| T _{TSD} | Thermal shutdown temperature | Die temperature T _J | 150 | 160 | 180 | °C |

6.6 Timing Requirements

$T_A = 25^\circ\text{C}$, $V_M = 5\text{ V}$, $V_{CC} = 3\text{ V}$, $R_L = 20\ \Omega$

| NO. | | | MIN | MAX | UNIT | |
|-----|-------------------|--|-----------------|-----|------|----|
| 1 | t ₁ | Delay time, PHASE high to OUT1 low | See Figure 6-1. | 160 | ns | |
| 2 | t ₂ | Delay time, PHASE high to OUT2 high | | 200 | ns | |
| 3 | t ₃ | Delay time, PHASE low to OUT1 high | | 200 | ns | |
| 4 | t ₄ | Delay time, PHASE low to OUT2 low | | 160 | ns | |
| 5 | t ₅ | Delay time, ENBL high to OUTx high | | 200 | ns | |
| 6 | t ₆ | Delay time, ENBL low to OUTx low | | 160 | ns | |
| 7 | t ₇ | Output enable time | See Figure 6-2. | 300 | ns | |
| 8 | t ₈ | Output disable time | | 300 | ns | |
| 9 | t ₉ | Delay time, INx high to OUTx high | | 160 | ns | |
| 10 | t ₁₀ | Delay time, INx low to OUTx low | | 160 | ns | |
| 11 | t ₁₁ | Output rise time | | 30 | 188 | ns |
| 12 | t ₁₂ | Output fall time | | 30 | 188 | ns |
| | t _{wake} | Wake time, nSLEEP rising edge to part active | | 30 | μs | |

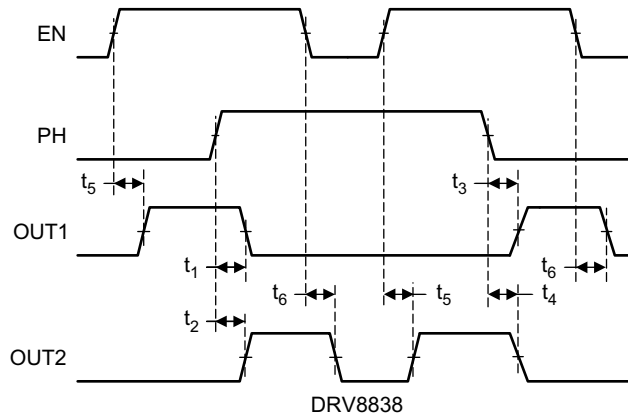


Figure 6-1. Input and Output Timing for DRV8838

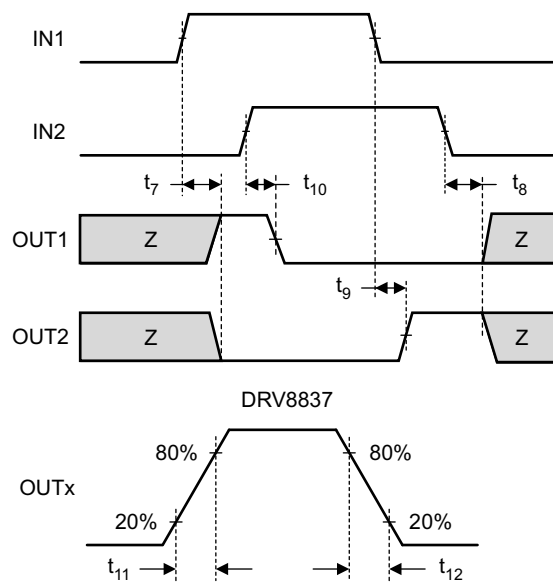


Figure 6-2. Input and Output Timing for DRV8837

6.7 Typical Characteristics

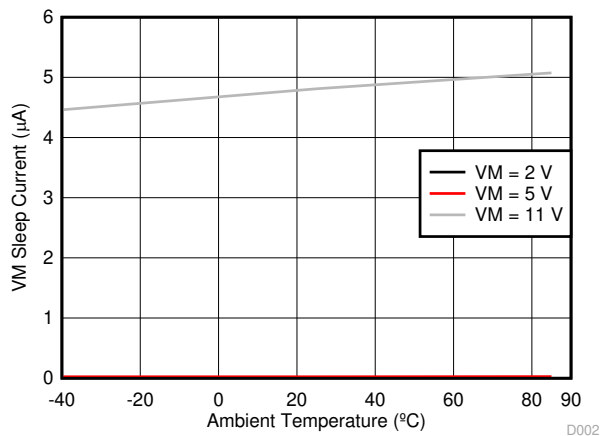


Figure 6-3. I_{VMQ} vs T_A

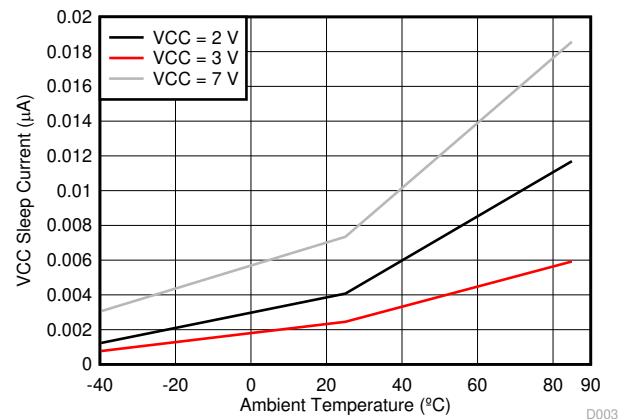


Figure 6-4. I_{VCCQ} vs T_A

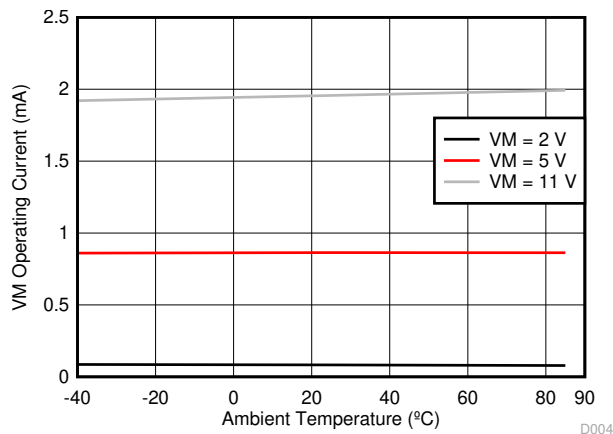


Figure 6-5. I_{VM} vs T_A (50-kHz PWM)

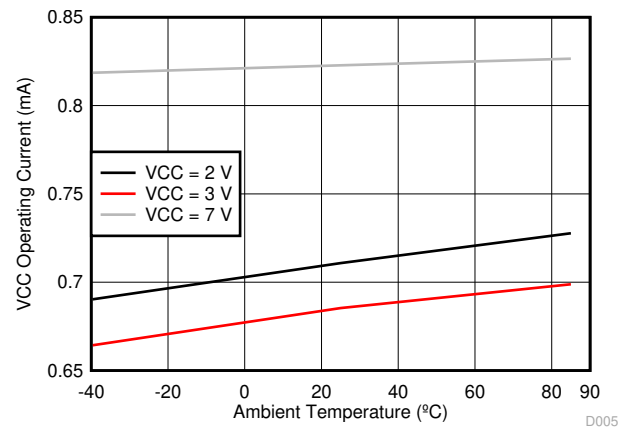


Figure 6-6. I_{VCC} vs T_A (50-kHz PWM)

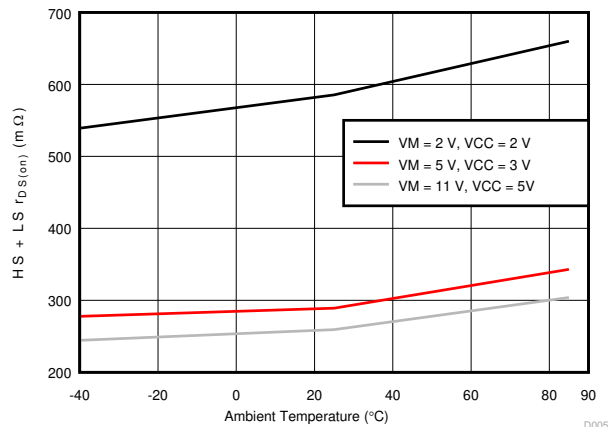


Figure 6-7. HS + LS $r_{DS(on)}$ vs T_A

7 Detailed Description

7.1 Overview

The DRV883x family of devices is an H-bridge driver that can drive one dc motor or other devices like solenoids. The outputs are controlled using either a PWM interface (IN1 and IN2) on the DRV8837 device or a PH-EN interface on the DRV8838 device.

A low-power sleep mode is included, which can be enabled using the nSLEEP pin.

These devices greatly reduce the component count of motor driver systems by integrating the necessary driver FETs and FET control circuitry into a single device. In addition, the DRV883x family of devices adds protection features beyond traditional discrete implementations: undervoltage lockout, overcurrent protection, and thermal shutdown.

7.2 Functional Block Diagram

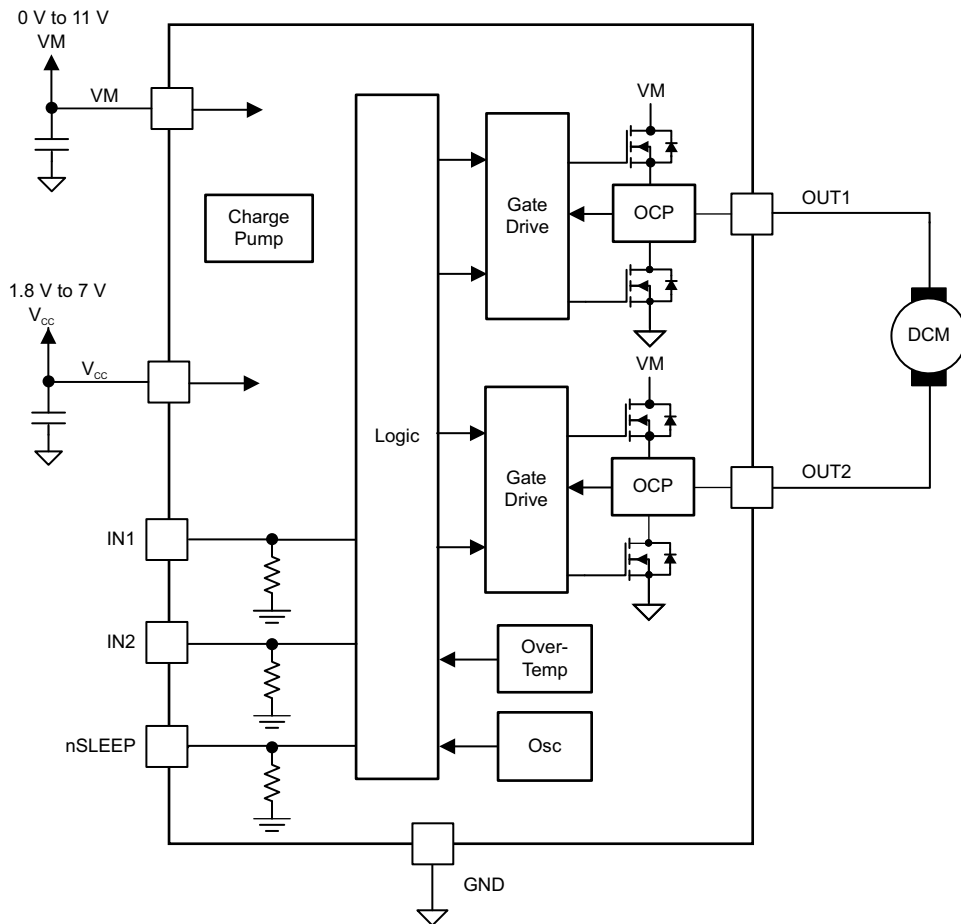


Figure 7-1. DRV8837 Functional Block Diagram

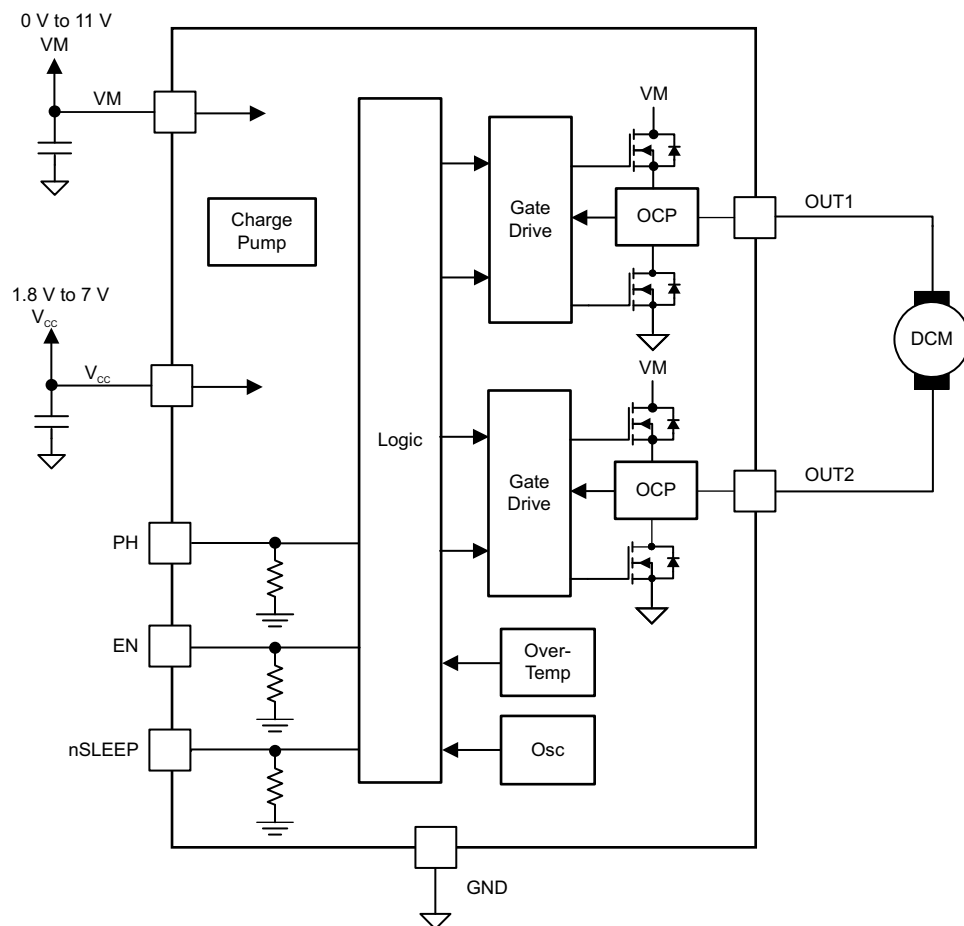


Figure 7-2. DRV8838 Functional Block Diagram

7.3 Feature Description

7.3.1 Bridge Control

The DRV8837 device is controlled using a PWM input interface, also called an IN-IN interface. Each output is controlled by a corresponding input pin.

Table 7-1 shows the logic for the DRV8837 device.

Table 7-1. DRV8837 Device Logic

| nSLEEP | IN1 | IN2 | OUT1 | OUT2 | FUNCTION (DC MOTOR) |
|--------|-----|-----|------|------|---------------------|
| 0 | X | X | Z | Z | Coast |
| 1 | 0 | 0 | Z | Z | Coast |
| 1 | 0 | 1 | L | H | Reverse |
| 1 | 1 | 0 | H | L | Forward |
| 1 | 1 | 1 | L | L | Brake |

The DRV8838 device is controlled using a PHASE/ENABLE interface. This interface uses one pin to control the H-bridge current direction, and one pin to enable or disable the H-bridge.

Table 7-2 shows the logic for the DRV8838.

Table 7-2. DRV8838 Device Logic

| nSLEEP | PH | EN | OUT1 | OUT2 | FUNCTION (DC MOTOR) |
|--------|----|----|------|------|---------------------|
| 0 | X | X | Z | Z | Coast |
| 1 | X | 0 | L | L | Brake |
| 1 | 1 | 1 | L | H | Reverse |
| 1 | 0 | 1 | H | L | Forward |

7.3.2 Independent Half-Bridge Control

Independent half-bridge control is possible with the DRV8837 without adopting more discrete components, as shown in Section 7.3.2. Two inductive loads (M1 and M2), which could be motors or solenoids, are tied between VM and OUTx, while the corresponding inputs (C1 and C2) are swapped before being fed to INx.

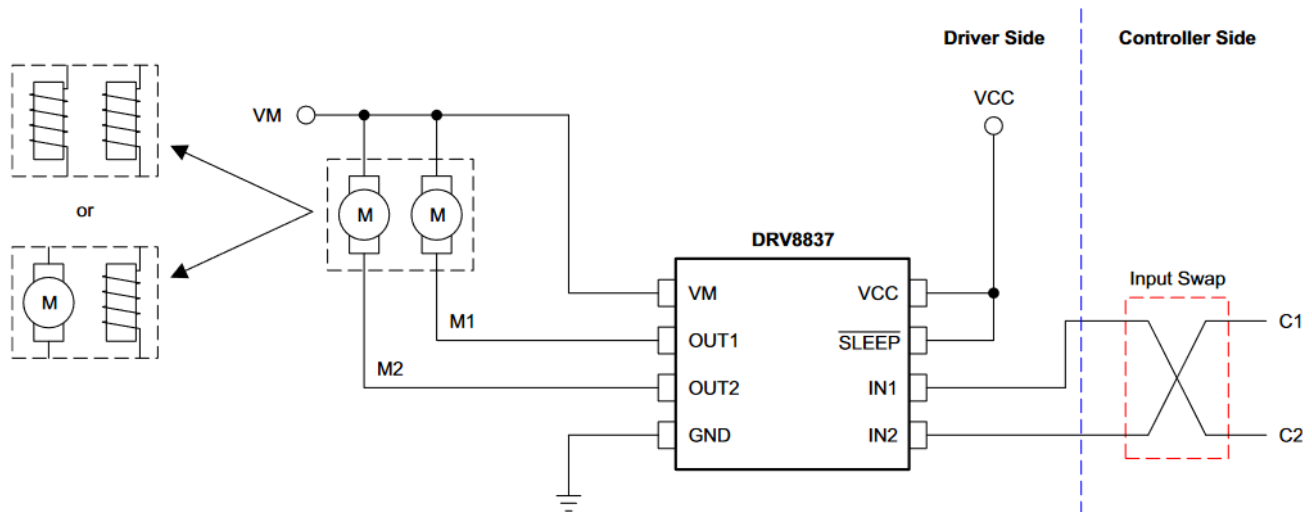


Figure 7-3. Independent Half-Bridge Control Circuit

The control logic for independent half-bridge drive is shown in Table 7-3. Columns INx and OUTx show the original logic of the DRV8837. Note that although a swap is included in this implementation, it is still valid that

Cx = 1 spins a motor or energizes a solenoid connected at corresponding Mx, while Cx = 0, stops the motor or discharges the solenoid.

Table 7-3. Independent Half-Bridge Drive Logic

| C1 | C2 | IN1 | IN2 | OUT1 | OUT2 | M1 | M2 |
|----|----|-----|-----|------|------|---------------------|---------------------|
| 0 | 0 | 0 | 0 | Z | Z | Off: Braking mode 1 | Off: Braking mode 1 |
| 1 | 0 | 0 | 1 | L | H | On: Driving mode | Off: Braking mode 2 |
| 0 | 1 | 1 | 0 | H | L | Off: Braking mode 2 | On: Driving mode |
| 1 | 1 | 1 | 1 | L | L | On: Driving mode | On: Driving mode |

Figure 7-4 shows the driving mode and the two current decay paths during current regulation when PWM input control is used. The driving mode occurs when the corresponding half-bridge Cx signal is **HIGH**. When the Cx signal is **LOW**, the corresponding half bridge can go into either braking mode 1 or braking mode 2. In braking mode 1, both the high- and low-side MOSFETs of the half-bridge are tri-stated, and the recirculation current flows through the body diode of the high-side MOSFET as well as the motor itself. This braking mode happens when both C1 and C2 are **LOW**. If one of the Cx input is **LOW** and the other HIGH, the half-bridge corresponding to the **LOW** Cx input will go into braking mode 2. In braking mode 2, the low-side FET is **OFF** while its high-side counterpart is **ON**. The recirculation current flows through the high-side MOSFET and the motor.

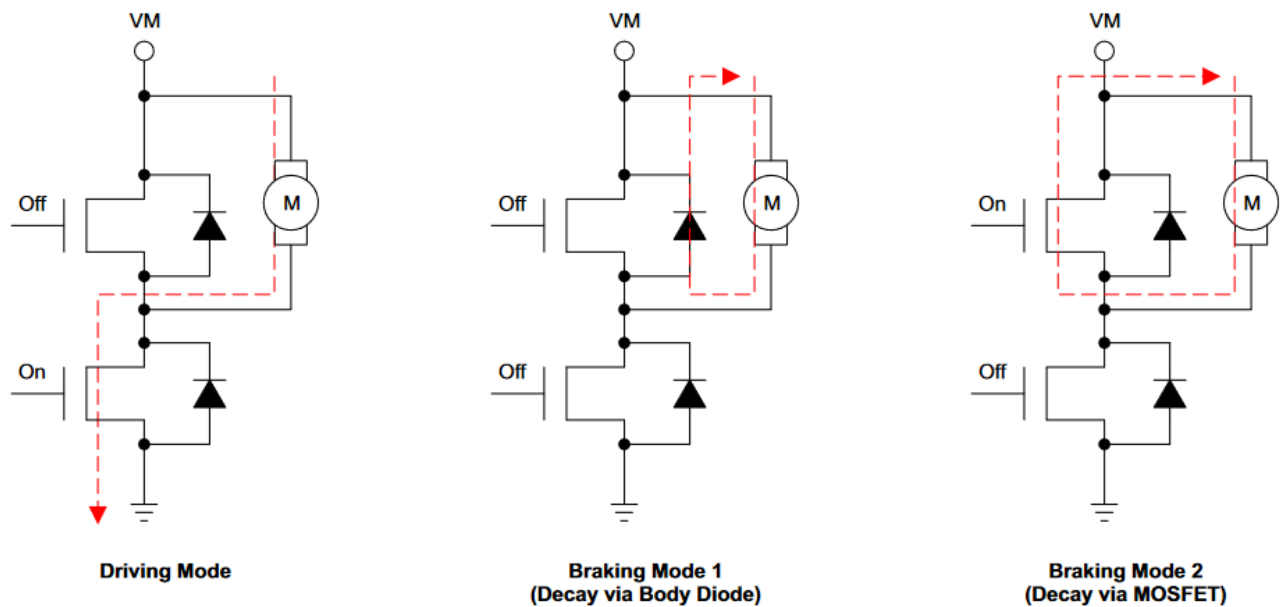


Figure 7-4. Normal Driving and Current Decay Modes

When each of the Cx inputs are independently controlled with different PWM frequencies and duty cycle, each half-bridge will go into a combination of braking mode 1 and braking mode 2. Figure 7-5 show a driving and decay example with independent PWM inputs. If the half-bridge spends more time in braking mode 1, the motor average speed will be lower since more power is dissipated through the MOSFET body diode. To reduce the power dissipated during braking mode 1, it is recommended to place Schottky diodes with forward voltage less than 0.6V across the motors as shown in Figure 7-6. Note that if On/Off control mode (constant HIGH or LOW at inputs) is used, the two braking modes do not interact with each other and hence have no effect on the average speed of the two motors.

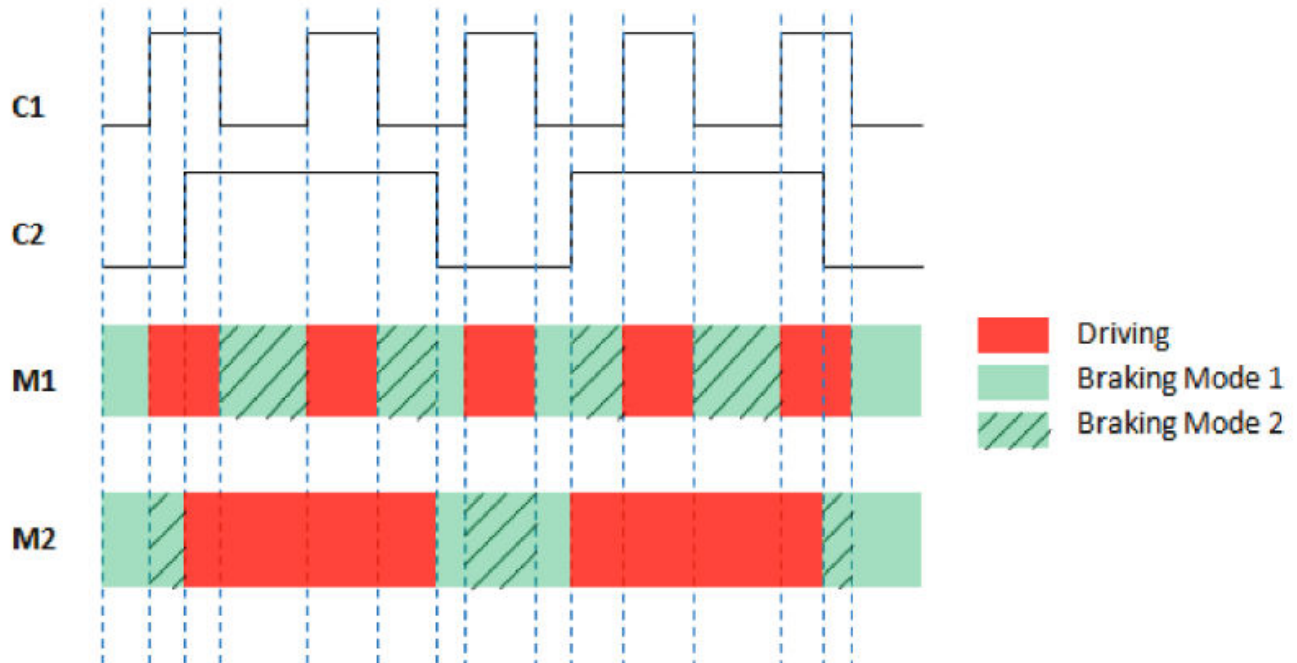


Figure 7-5. Driving and Decay Examples with Independent PWM Inputs

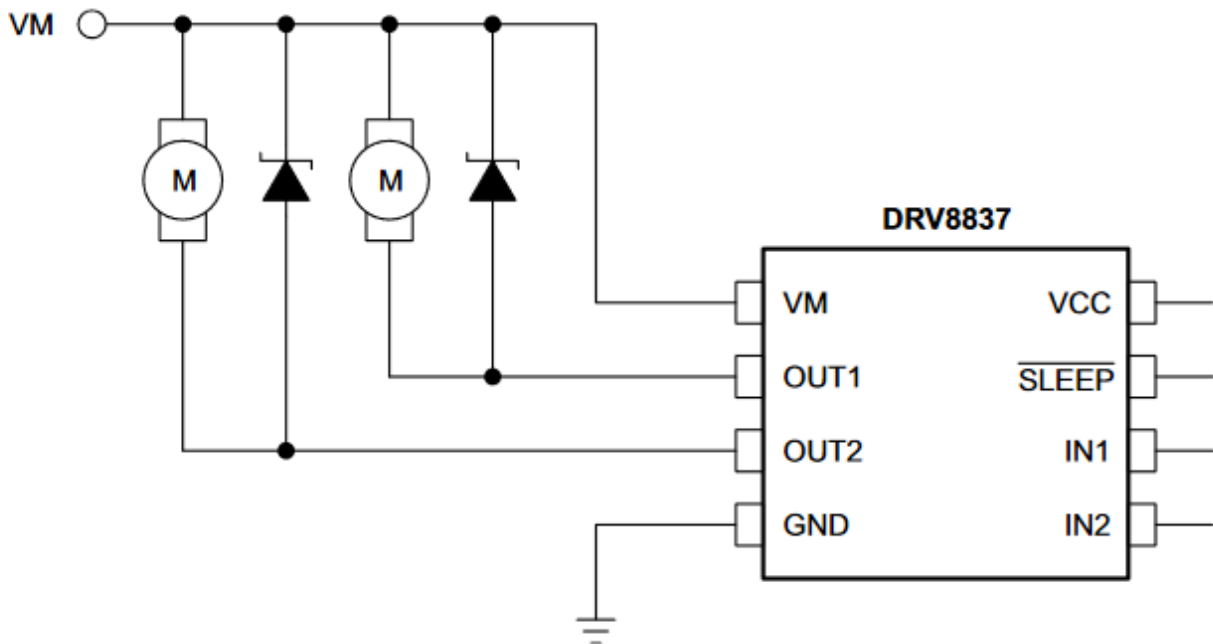


Figure 7-6. Improved Application Circuit for Better Motor Performance

7.3.3 Sleep Mode

If the nSLEEP pin is brought to a logic-low state, the DRV883x family of devices enters a low-power sleep mode. In this state, all unnecessary internal circuitry is powered down.

7.3.4 Power Supplies and Input Pins

The input pins can be driven within the recommended operating conditions with or without the VCC, VM, or both power supplies present. No leakage current path will exist to the supply. Each input pin has a weak pulldown resistor (approximately 100 k Ω) to ground.

The VCC and VM supplies can be applied and removed in any order. When the VCC supply is removed, the device enters a low-power state and draws very little current from the VM supply. The VCC and VM pins can be connected together if the supply voltage is between 1.8 and 7 V.

The VM voltage supply does not have any undervoltage-lockout protection (UVLO) so as long as VCC > 1.8 V; the internal device logic remains active, which means that the VM pin voltage can drop to 0 V. However, the load cannot be sufficiently driven at low VM voltages.

7.3.5 Protection Circuits

The DRV883x family of devices is fully protected against VCC undervoltage, overcurrent, and overtemperature events.

7.3.5.1 VCC Undervoltage Lockout

If at any time the voltage on the VCC pin falls below the undervoltage lockout threshold voltage, all FETs in the H-bridge are disabled. Operation resumes when the VCC pin voltage rises above the UVLO threshold.

7.3.5.2 Overcurrent Protection (OCP)

An analog current-limit circuit on each FET limits the current through the FET by removing the gate drive. If this analog current limit persists for longer than t_{DEG} , all FETs in the H-bridge are disabled. Operation resumes automatically after t_{RETRY} has elapsed. Overcurrent conditions are detected on both the high-side and low-side FETs. A short to the VM pin, GND, or from the OUT1 pin to the OUT2 pin results in an overcurrent condition.

7.3.5.3 Thermal Shutdown (TSD)

If the die temperature exceeds safe limits, all FETs in the H-bridge are disabled. After the die temperature falls to a safe level, operation automatically resumes.

7.3.5.4

Table 7-4. Fault Behavior

| FAULT | CONDITION | H-BRIDGE | RECOVERY |
|-------------------------|--|----------|----------------------------|
| VCC undervoltage (UVLO) | VCC < 1.7 V | Disabled | VCC > 1.8 V |
| Overcurrent (OCP) | $I_{\text{OUT}} > 1.9 \text{ A (MIN)}$ | Disabled | t_{RETRY} elapses |
| Thermal Shutdown (TSD) | $T_J > 150^\circ\text{C (MIN)}$ | Disabled | $T_J < 150^\circ\text{C}$ |

7.4 Device Functional Modes

The DRV883x family of devices is active unless the nSLEEP pin is brought logic low. In sleep mode, the H-bridge FETs are disabled Hi-Z. The DRV883x is brought out of sleep mode automatically if nSLEEP is brought logic high.

The H-bridge outputs are disabled during undervoltage lockout, overcurrent, and overtemperature fault conditions.

Table 7-5. Operation Modes

| MODE | CONDITION | H-BRIDGE |
|-------------------|-------------------------|-----------|
| Operating | nSLEEP pin = 1 | Operating |
| Sleep mode | nSLEEP pin = 0 | Disabled |
| Fault encountered | Any fault condition met | Disabled |

Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

The DRV883x family of devices is device is used to drive one dc motor or other devices like solenoids. The following design procedure can be used to configure the DRV883x family of devices.

8.2 Typical Application

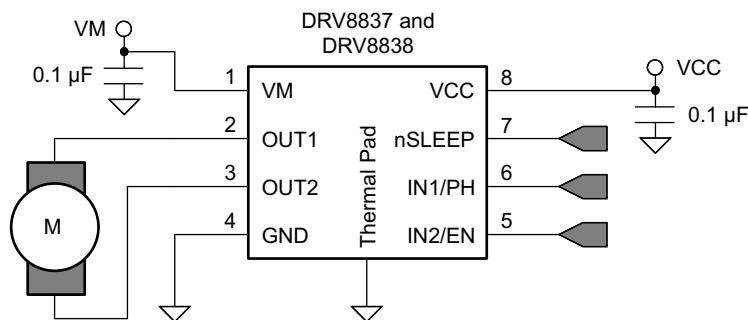


Figure 8-1. Schematic of DRV883x Application

8.2.1 Design Requirements

Table 8-1 lists the required parameters for a typical usage case.

Table 8-1. System Design Requirements

| DESIGN PARAMETER | REFERENCE | EXAMPLE VALUE |
|----------------------|------------------|---------------|
| Motor supply voltage | VM | 9 V |
| Logic supply voltage | VCC | 3.3 V |
| Target rms current | I _{OUT} | 0.8 A |

8.2.2 Detailed Design Procedure

8.2.2.1 Motor Voltage

The appropriate motor voltage depends on the ratings of the motor selected and the desired RPM. A higher voltage spins a brushed dc motor faster with the same PWM duty cycle applied to the power FETs. A higher voltage also increases the rate of current change through the inductive motor windings.

8.2.2.2 Low-Power Operation

When entering sleep mode, TI recommends setting all inputs as a logic low to minimize system power.

8.2.3 Application Curves

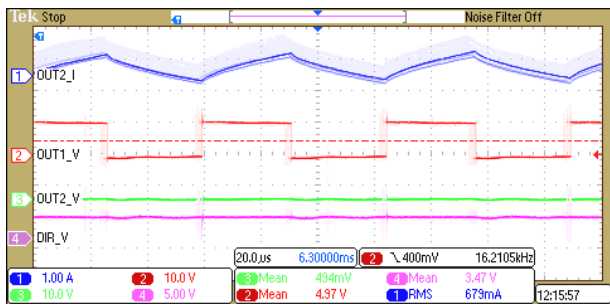


Figure 8-2. 50% Duty Cycle, Forward Direction

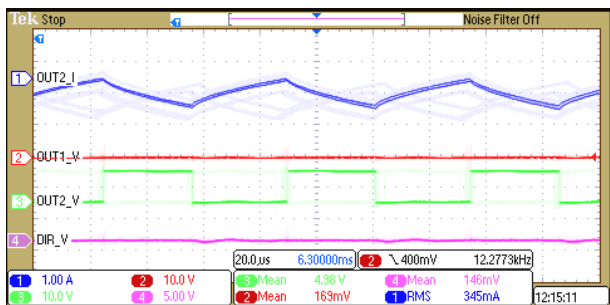


Figure 8-3. 50% Duty Cycle, Reverse Direction

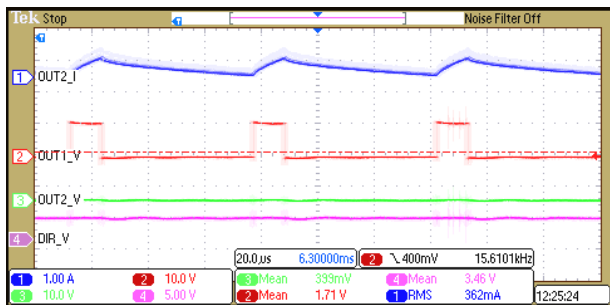


Figure 8-4. 20% Duty Cycle, Forward Direction

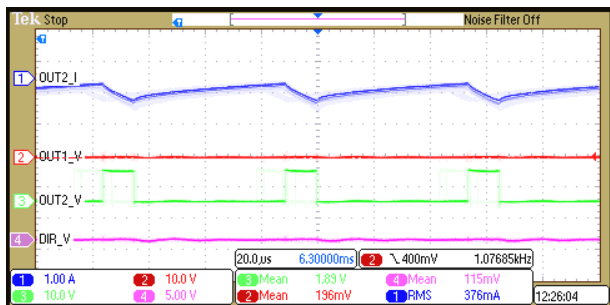


Figure 8-5. 20% Duty Cycle, Reverse Direction

Note

DIR_V is an indication of the motor direction. It is not a pin of the DRV883x device.

8 Power Supply Recommendations

8.1 Bulk Capacitance

Having appropriate local bulk capacitance is an important factor in motor-drive system design. It is generally beneficial to have more bulk capacitance, while the disadvantages are increased cost and physical size.

The amount of local capacitance needed depends on a variety of factors, including:

- The highest current required by the motor system
- The power-supply capacitance and ability to source current
- The amount of parasitic inductance between the power supply and motor system
- The acceptable voltage ripple
- The type of motor used (brushed dc, brushless dc, stepper)
- The motor braking method

The inductance between the power supply and motor drive system limits the rate at which current can change from the power supply. If the local bulk capacitance is too small, the system responds to excessive current demands or dumps from the motor with a change in voltage. When adequate bulk capacitance is used, the motor voltage remains stable and high current can be quickly supplied.

The data sheet generally provides a recommended value, but system-level testing is required to determine the appropriate size of bulk capacitor.

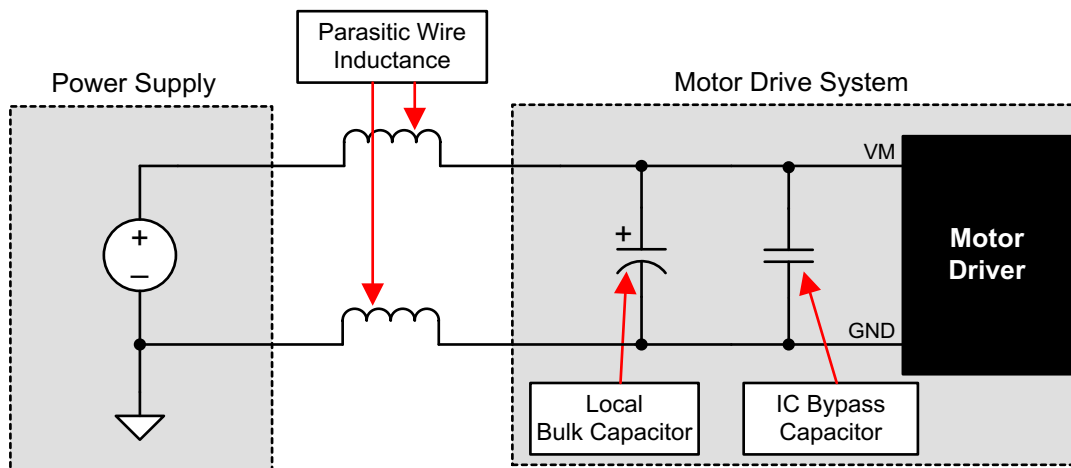


Figure 8-1. Example Setup of Motor Drive System With External Power Supply

The voltage rating for bulk capacitors should be higher than the operating voltage, to provide margin for cases when the motor transfers energy to the supply

9 Layout

9.1 Layout Guidelines

The VM and VCC pins should be bypassed to GND using low-ESR ceramic bypass capacitors with a recommended value of 0.1 μF rated for VM and VCC. These capacitors should be placed as close to the VM and VCC pins as possible with a thick trace or ground plane connection to the device GND pin.

9.2 Layout Example

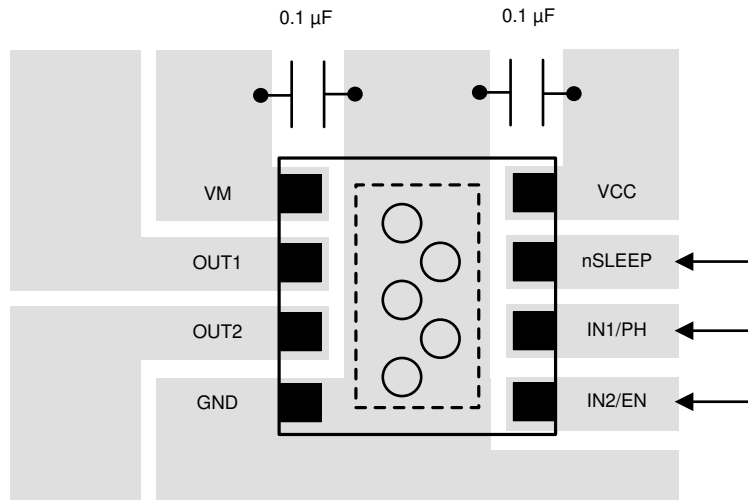


Figure 9-1. Simplified Layout Example

9.3 Power Dissipation

Power dissipation in the DRV883x family of devices is dominated by the power dissipated in the output FET resistance, or $r_{\text{DS(on)}}$. Use Equation 1 to estimate the average power dissipation when running a stepper motor.

$$P_{\text{TOT}} = r_{\text{DS(on)}} \times (I_{\text{OUT(RMS)}})^2 \quad (1)$$

where

- P_{TOT} is the total power dissipation
- $r_{\text{DS(on)}}$ is the resistance of the HS plus LS FETs
- $I_{\text{OUT(RMS)}}$ is the rms or dc output current being supplied to the load

The maximum amount of power that can be dissipated in the device is dependent on ambient temperature and heatsinking.

Note

The value of $r_{\text{DS(on)}}$ increases with temperature, so as the device heats, the power dissipation increases.

The DRV883x family of devices has thermal shutdown protection. If the die temperature exceeds approximately 150°C, the device is disabled until the temperature drops to a safe level.

Any tendency of the device to enter thermal shutdown is an indication of either excessive power dissipation, insufficient heatsinking, or too high an ambient temperature.

10 Device and Documentation Support

10.1 Documentation Support

10.1.1 Related Documentation

For related documentation see the following:

- [Calculating Motor Driver Power Dissipation](#)
- [DRV8837EVM User's Guide](#)
- [DRV8838EVM User's Guide](#)
- [Independent Half-Bridge Drive with DRV8837](#)
- [Understanding Motor Driver Current Ratings](#)

10.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 10-1. Related Links

| PARTS | PRODUCT FOLDER | SAMPLE & BUY | TECHNICAL DOCUMENTS | TOOLS & SOFTWARE | SUPPORT & COMMUNITY |
|---------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| DRV8837 | Click here | Click here | Click here | Click here | Click here |
| DRV8838 | Click here | Click here | Click here | Click here | Click here |

10.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

10.4 Community Resources

10.5 Trademarks

All trademarks are the property of their respective owners.

Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|-----------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| DRV8837DSGR | Active | Production | WSON (DSG) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 837 |
| DRV8837DSGR.Z | Active | Production | WSON (DSG) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 837 |
| DRV8837DSGRG4.Z | Active | Production | WSON (DSG) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 837 |
| DRV8837DSGT | Obsolete | Production | WSON (DSG) 8 | - | - | Call TI | Call TI | -40 to 85 | 837 |
| DRV8838DSGR | Active | Production | WSON (DSG) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 838 |
| DRV8838DSGR.Z | Active | Production | WSON (DSG) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 838 |
| DRV8838DSGRG4.Z | Active | Production | WSON (DSG) 8 | 3000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 838 |
| DRV8838DSGT | Obsolete | Production | WSON (DSG) 8 | - | - | Call TI | Call TI | -40 to 85 | 838 |

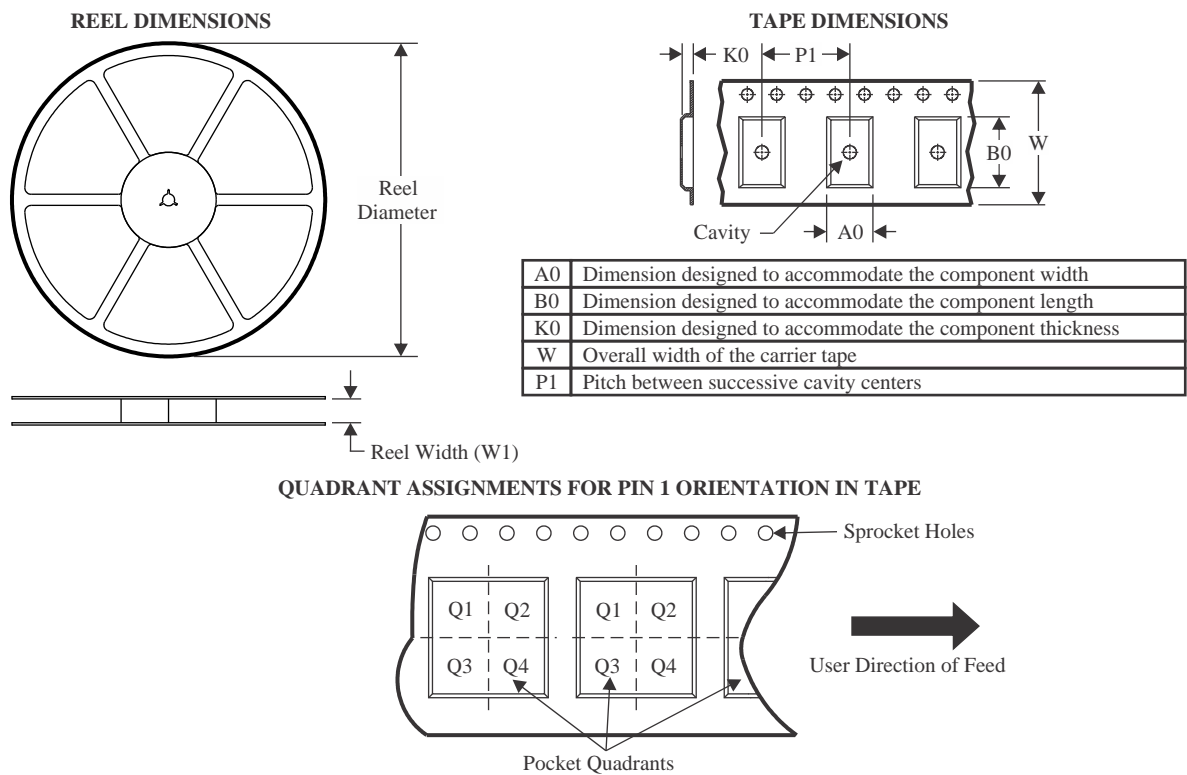
- (1) **Status:** For more details on status, see our [product life cycle](#).
- (2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.
- (3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.
- (4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.
- (5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.
- (6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

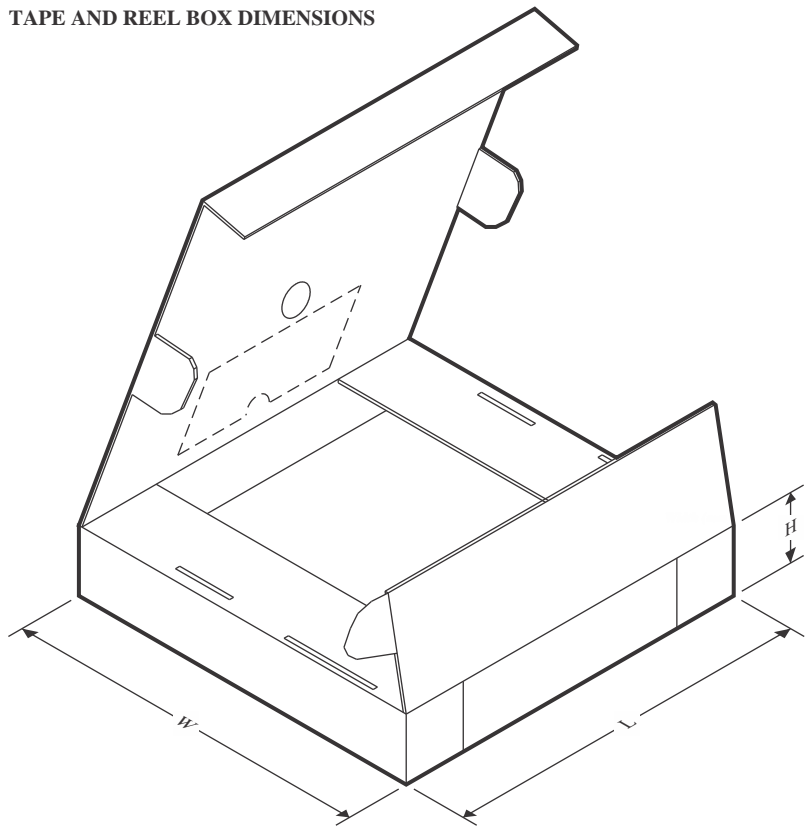
TAPE AND REEL INFORMATION



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| DRV8837DSGR | WSO | DSG | 8 | 3000 | 180.0 | 8.4 | 2.3 | 2.3 | 1.15 | 4.0 | 8.0 | Q2 |
| DRV8837DSGR | WSO | DSG | 8 | 3000 | 180.0 | 8.4 | 2.3 | 2.3 | 1.15 | 4.0 | 8.0 | Q2 |
| DRV8838DSGR | WSO | DSG | 8 | 3000 | 180.0 | 8.4 | 2.3 | 2.3 | 1.15 | 4.0 | 8.0 | Q2 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| DRV8837DSGR | WSN | DSG | 8 | 3000 | 182.0 | 182.0 | 20.0 |
| DRV8837DSGR | WSN | DSG | 8 | 3000 | 210.0 | 185.0 | 35.0 |
| DRV8838DSGR | WSN | DSG | 8 | 3000 | 182.0 | 182.0 | 20.0 |

GENERIC PACKAGE VIEW

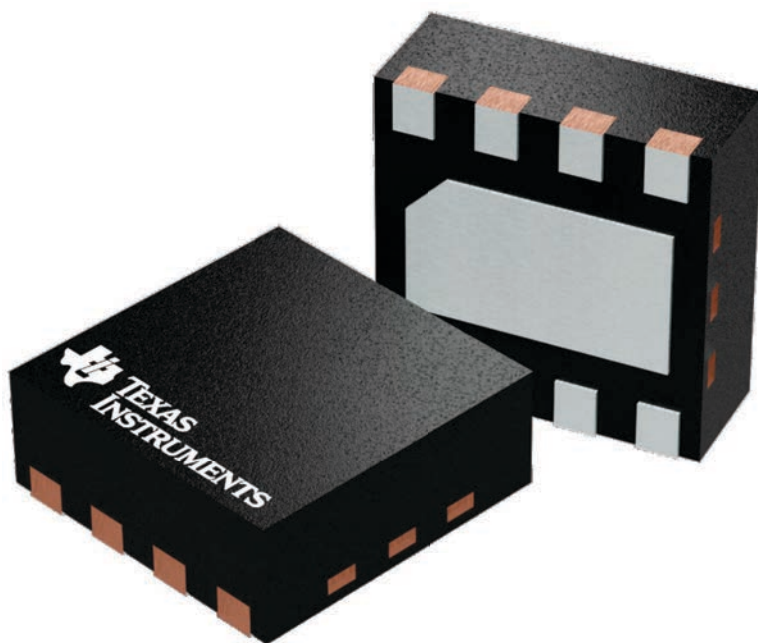
DSG 8

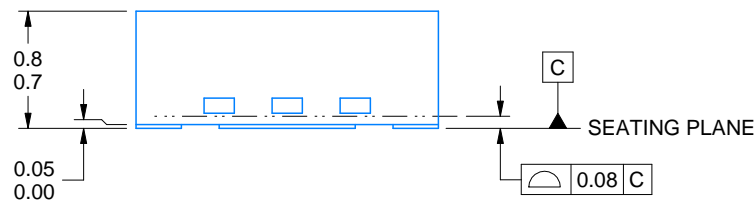
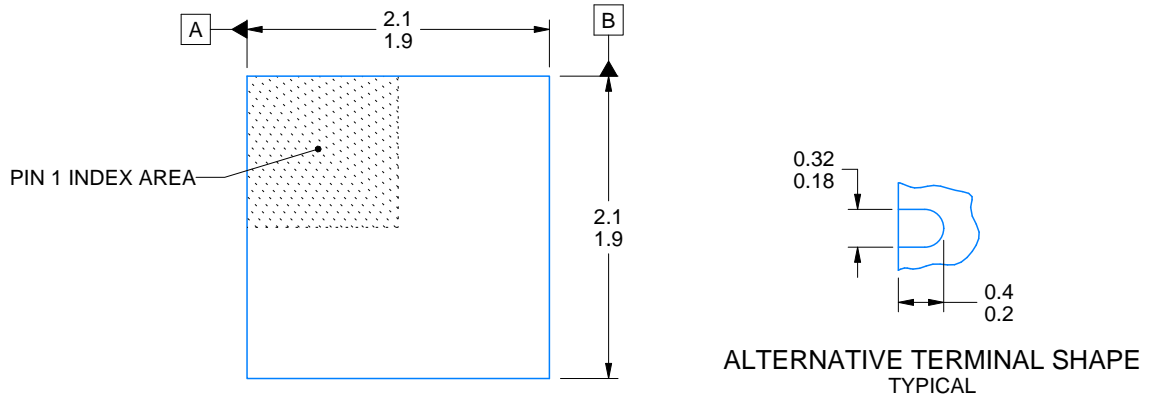
WSON - 0.8 mm max height

2 x 2, 0.5 mm pitch

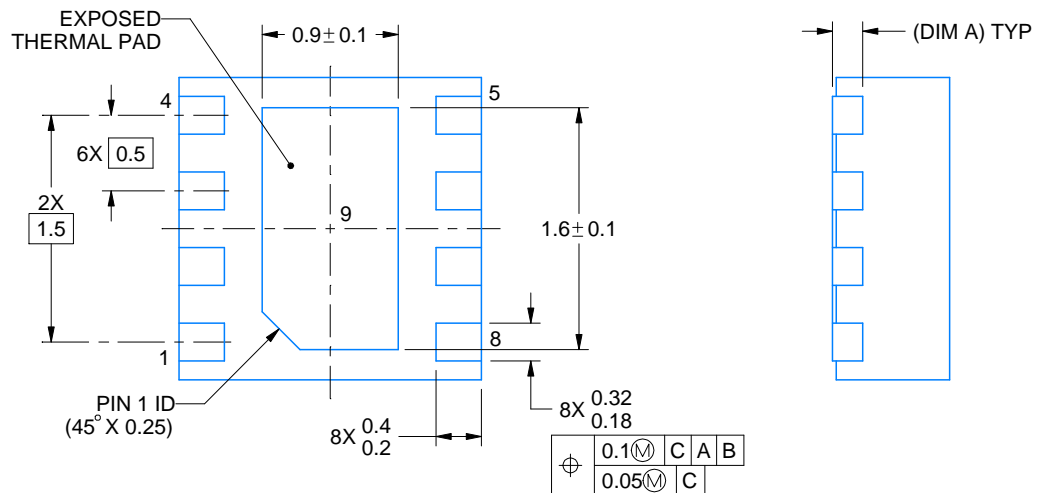
PLASTIC SMALL OUTLINE - NO LEAD

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.





| SIDE WALL METAL THICKNESS DIM A | |
|---------------------------------------|----------|
| OPTION 1 | OPTION 2 |
| 0.1 | 0.2 |



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NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

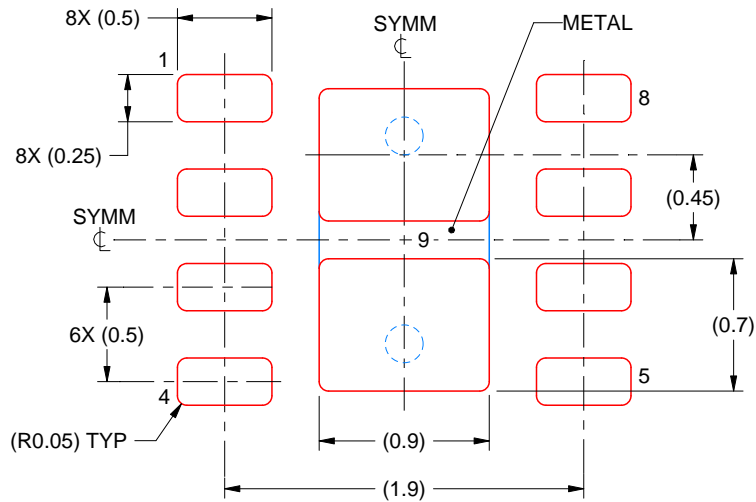
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

DSG0008A

WSN - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 9:
87% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:25X

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NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.